Before the
FEDERAL COMMUNICAIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
Inquiry Regarding Carrier Current	)	
Systems, including Broadband over	)	ET Docket No. 03-104
Power Line Systems	)	

REPLY COMMENTS OF
GARY W. BOX
To Comments of
CURRENT TECHNOLOGIES
Dated 7 July 2003

These are Reply Comments of Gary W. Box to comments filed by Current Technologies.

The writer received a BSEE and MSEE from UCLA, 1977 and has been employed as a electrical engineer involved in the power electronics and industrial electronics industries for 29 years, mainly in product development. This experience includes numerous encounters with FCC emission requirements including designing, building and testing equipment for compliance. The writer has also been issued 9 patents and currently holds the call sign N0JCG as a member of the Amateur Radio Service.

These replies take the form of excerpts from Current Technologies original comment, noted as "Comment," followed by reply remarks, noted as "Reply". A number annotates each Comment and Reply. Replies commence immediately below.

1. COMMENT
"Some parties to this proceeding assume the entire length of a BPL-equipped power line emits radio frequency noise, and hence evoke the frightening image of a miles long transmitting antenna. That is simply wrong. BPL emissions come almost entirely from a short segment of line immediately adjacent to where the BPL device is attached." "BPL uses the wires only as a conducted transmission medium, and has no more inherent propensity for causing interference than does any other unintentional digital emitter."

REPLY
In order for BPL to work at all, RF energy must be conducted along the entire path from the transmitting device to the receiving device. All parties to the NOI, including Current Technologies, admit that the power line is an unbalanced system relative to RF. RF energy fed into an unbalanced system of conductors is precisely the definition of an antenna, thus the entire line will radiate. The intensity of the radiation will fall off as the signal passes from line segment to line segment because a good deal of the energy is radiated. Current Technologies is right that this property would be the same for BPL signals as it is for other noise sources, since the power line does not care what the source of the excitation is. The problem is that Current Technologies is proposing to overcome this conducted transmission loss by increasing the level of transmission well beyond Class A conducted limits.

2. COMMENT
"The overall bandwidth of a BPL system has no bearing on its propensity to interfere with any given receiver. In principle, perhaps, the higher bandwidth might be said to impact more receivers from a given BPL system. But it does not happen that way. Because BPL emissions are local to a point source and do not aggregate, even a wide bandwidth has little effect on a system's potential for interference to the overall population of receivers."

REPLY
Recent tests by the American Radio Relay League (ARRL) using a conventional mobile amateur radio configuration documented substantial harmful interference from several BPL systems. Current Technologies has described its BPL system as a wide band system using OFDM modulation to avoid frequencies in the amateur bands. Let's assume that a spectrum analysis of the BPL signal shows no BPL carriers in the amateur bands. How then did the sensitive narrow bandwidth amateur receiver pick up the out of band BPL signal? If we examine the characteristics of the received noise, we see that most of the interference is a series of random 'pops', which one party described as sounding like a 'Geiger counter'. They were very short, but very often, impulse noise transients. OFDM modulation creates as many as 256 (or more) discrete RF carriers and imposes a separate bit stream on each. The 256 carriers suddenly appear, transmit their bit streams, which form the packet, and then are extinguished. If the leading and trailing edges of these carriers are not controlled, the edge of each packet will look like an impulse excitation to the power line. The spectrum of an impulse is spread infinitely across the spectrum. The power line obediently reacts to this excitation as the distributed, unbalanced, resonate wire structure it is and an impulse of energy is radiated all across the HF spectrum. The phenomena would occur at every edge of every packet.

In the Amateur Radio Service this effect has been known for 80 years as "key click". A CW (Morse code) transmitter operates by turning the carrier on and off as the key is opened and closed, in much the same way that the BPL OFDM signal turns its 256 carriers on and off, although at a considerably slower rate. In CW, 'key click' is fixed by controlling the rise and fall times of the RF envelope, effectively passing the RF envelope through a low pass filter.

Unfortunately for BPL, passing the signal through a low pass filter will slow the baud rate substantially. OFDM works great in a band where all users are using the same modulation scheme because OFDM itself has good immunity to this effect. This is why there should be no conflict between access and in-home BPL. However, on the HF band, where the development emphasis over the last 100 years has been on raising signal to noise performance by designing ever-sharper filters and highly bandwidth conserving modulation schemes, a mode that continually generates impulse noise is incompatible.

3. COMMENT
"Rules to limit interference should consist of a field strength specification at a particular distance. Manufacturers and providers should have full flexibility in how they achieve compliance."

REPLY
In this statement, Current Technology is indirectly asking the Commission to waive the two most important precepts of Part 15 operation, namely that a Part 15 device must not cause interference to a licensed service and that a Part 15 must accept interference from a licensed service. This is totally unacceptable. Unlicensed operation can never be allowed to have priority or even equal footing with licensed services unless they themselves become licensed, especially in the HF bands where long distance transmission of RF energy is particularly efficient. To do otherwise would be to return to the chaos of the spark transmitter.

4. COMMENT
"Field strength specifications should allow higher emissions in parts of the spectrum where they do not threaten interference."

REPLY
Of the entire electromagnetic spectrum, from DC to light, only the tiny sliver between 1 and 30 MHz is capable of unassisted, worldwide communication using little power and absolutely no infrastructure. The Amateur Radio Service demonstrates this fact daily. How does Current Technologies propose to identify the parts of the spectrum where they do not threaten interference? If Current Technologies avoids transmitting in just the amateur, short-wave broadcast bands and utility portions of the band, that would leave little spectrum for their operation and throughput will suffer accordingly.

5. COMMENT

"Conducted emissions should not be regulated at all, outside the AM broadcast band, because they have no direct bearing on interference. Even an implementation that results in high conducted emissions should be unobjectionable so long as the radiated emissions stay within limits."

REPLY
With this, and other comments, Current Technologies makes it clear that they are seeking to have the Commission impose the highest possible RF emission limits on BPL technology. They are thus admitting that the power line is a poor conductor of RF and they need to increase the radiated energy level as high as possible to get sufficient performance. The conducted limits were set after significant study by the FCC. The power distribution system will react the same to RF energy whether it is from noise or intentional BPL injection. Experience has shown that the power lines and related hardware are capable of RF gain and mixing, which are some reasons the limits were imposed in 1989. By raising the conducted limits the commission would be throwing out almost 20 years of progress in suppressing unintentional HF RF emissions.

4. COMMENT
"The American public needs BPL, both to provide ubiquitous, low-cost broadband access where it is not otherwise available, and also to provide meaningful competition to existing broadband platforms."

REPLY
Access BPL is not the only way the utilities can achieve these goals. In fact it is not the most economical, easiest deployed, or reliable of the choices available to the utility. I would like to remind the Commission of their recent work on establishing the Unlicensed National Information Infrastructure band at 5Ghz. The very function of Access BPL is to be part of this infrastructure. It seems only logical that the utilities also use the U-NII band for this purpose. By mounting U-NII nodes on power poles at appropriate intervals (between 1 and 10 miles), all the goals of the Commission, the utilities and even the manufacturers can be achieved without causing interference to any HF users. Perhaps more importantly, U-NII implementations such as the Motorola Canopy system can be deployed immediately, without any further Commission action or any further cost to the Federal Government.

The advantages of using the U-NII band over BPL are numerous:

1. No interference to any users in HF.
2. No need for frequency notches.
3. No direct connection to power line, other than for power.
4. Independent of powerline noise.
5. Independent of powerline impedance characteristics.
6. Independent of power grid switching
7. Independent of powerline reliability, with battery backup.
8. Independent of powerline routing. Only pole location is important.
9. Freedom to configure the network as desired; either with directional antennas or omnis.
10. No safety concerns.
11. No interference liability for the utility.
12. Cheaper hardware (5Ghz transverter should be cheaper than powerline inductive components).
13. Lower radiated RF power
14. Lower power consumption overall. Could be solar powered
15. System robustness
16. FCC gets its "third wire".
17. Providing rural service is trivial.
18. Strap-on installation means neighborhoods could be "wired" in hours, not months.
19. Cheaper installation
20. Little or no rule changes needed.
21. Bandwidth is almost four times wider than BPL, leading to higher performance.